Data Evaluation Record (DER)

Chemical names	CAS number	PC code
Dicamba: diglycoamine (DGA) salt	104040-79-1 (DGA salt)	128931 (DGA salt)
Dicamba: dimethylamine (DMA) salt	2300-66-5 (DMA salt)	029802 (DMA salt)
Dicamba: acid	1918-00-9 (Dicamba acid)	029801 (Dicamba acid)

Study Citation:
MRID 49925703.
Gavlick, W.K. 2016. Determination of Plant Response as a Function of Dicamba Vapor Concentration in a Closed Dome System. Unpublished study prepared by Monsanto Company. Study Number REG-2016-0170.

Purpose of Review (Note: DP Barcode required for Quantitative studies): Dicamba DGA field buffer distance evaluation; DP 434344

Date of Review: 11/8/2016

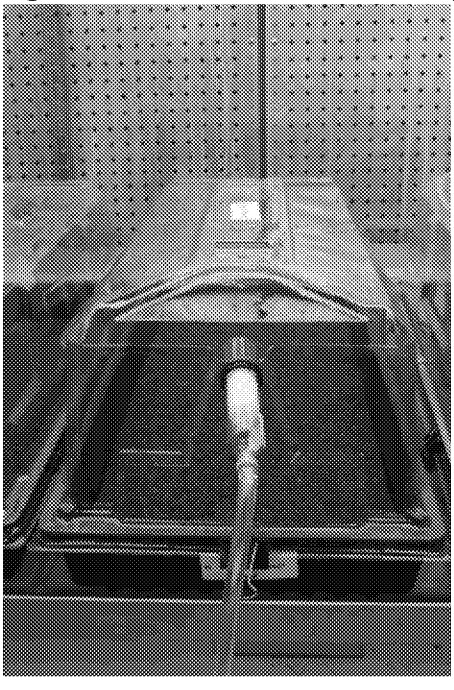
Summary of Study Findings: Soybean plants (*Glycine max*; variety AG2632) at the V2 growth stage at study initiation were exposed to various volatilized dicamba formulations in closed dome systems for 24 hours. The specific dicamba formulations tested are identified by treatment in **Table 1**. It appears that some dicamba formulations were combined within individual treatments to create a dicamba vapor exposure concentration series. Each treatment was replicated three times with four soybean plants per replicate. For each treatment and replicate, six petri dishes (90mm ID, glass) were sprayed with the specific dicamba formulation at a rate equivalent to 10 gallons product per acre and placed in a closed dome system with the soybean plants (petri dishes in the control were not sprayed). Each humidome (**Figure 1**) was connected to a vacuum pump that circulated air through the humidome, plastic tubing, and a polyurethane foam filter at a rate of two standard liters per minute for 24 hours (atmospheric conditions in the humidome were maintained at 85°F for 16 hours and 70°F for 8 hours with 40% relative humidity). Following the 24 hour exposure to dicamba vapor in the closed dome systems, the soybean plants were moved to a greenhouse for 21 days. Visual phytotoxic responses were evaluated on days 14 and 21 post-treatment and plant height measurement were taken on day 21 post-treatment. Also following the completion of the 24 hour exposure phase, the polyurethane foam filter was removed and the dicamba trapped by the filter was extracted using methanol and quantified using LC-MS.

Table 1. Dicamba treatments, weight percent dicamba acid, and test chamber mean measured dicamba acid concentrations

Treatment Number	(w/w) Composition	(w/w) Dicamba Acid	Mean Measured Dicamba Acid Concentration (µg/m³)
1	100% M1691 (1.2% ae)	1.2%	0.0177
2	75% M1691 (1.2% ae) & 25% Banvel® (1.2% ae)	1.2%	0.539
3	50% M1691 (1.2% ae) & 50% Banvel® (1.2% ae)	1.2%	1.002
4	25% M1691 (1.2% ae) & 75% Banvel® (1.2% ae)	1.2%	1.004
5	100% Banvel® (1.2% ae)	1.2%	1.597
6	50% Banvel® (1.2% ae) & 50% Dicamba Acid (0.45% ae)	0.83%	3.059
7	25% Banvel® (1.2% ae) & 75% Dicamba Acid (0.45% ae)	0.64%	2.881
8	No treatment	Zero	None detected

M1691 active ingredient: dicamba DGA salt
Banvel® active ingredient: dicamba DMA salt

Figure 1. Picture of a humidome apparatus used in the study



Results:

Plant height was statistically significantly reduced compared to the control at vapor-phase exposure to dicamba at air concentrations of 0.539 µg/m^3 and above based on the study author's analysis (**Table 2**). No significant decrease in plant height was seen at the 0.0177 µg/m^3 vapor-phase dicamba air concentration based on the study author's analysis, making this treatment concentration the study NOAEC.

Table 2. Mean Dicamba Exposure Concentrations and Mean Plant Height Across Three Replicates

Treatment Number	Mean Measured Dicamba Acid Concentration (µg/m^3)	Mean Plant height (cm)
1	0.0177	29.21
2	0.539	19.46*
3	1.002	19.96*
4	1.004	17.70*
5	1.597	20.92*
6	3.059	15.54*
7	2.881	11.67*
8	None detected	28.79

*Height values with an asterisk are statistically significantly reduced compared to the control (treatment 8)

Study Classification: While this study was not conducted per an EPA OCSPP guideline protocol (no such protocol exists), it was conducted in accordance with Good Laboratory Practice standards. The study is scientifically sound and classified as supplemental, suitable for quantitative use in risk assessment.

Rationale for Use: The explicit purpose of this study was "to examine the relationship between dicamba vapor concentration and plant response to identify a no observed effect concentration that can be used to support the risk assessment for dicamba use on dicamba-tolerant crops." Analytical and biological results were obtained. The analytical results explain that, percent acid equivalency dicamba applied being equal, the DGA form of applied dicamba is less volatile than the other dicamba formulations (*i.e.*, dicamba DMA and dicamba acid) as indicated by the amount of dicamba extracted from the polyurethane foam filter compared to the other formulations. The biological results indicate that soybean height is not significantly reduced compared to control plants following 24 hours of exposure (at 85°F for 16 hours and 70°F for 8 hours with 40% relative humidity) to vapor-phase dicamba at concentrations less than or equal to 0.0177 µg/m^3; however, 24 hour exposure (at 85°F for 16 hours and 70°F for 8 hours with 40% relative humidity) to concentrations of vapor-phase dicamba greater than or equal to 0.539 µg/m^3 significantly reduced soybean height compared to control plants.

Limitations of Study: It is notable that the dose spacing in this study results in an approximately 30x difference between the NOAEC and LOAEC, creating uncertainty as to where effects to

plants from vapor-phase exposure to dicamba may occur. Generally, definitive toxicity studies are conducted with lower dose-spacing (*e.g.* 1.5-3x geometric spacing between doses). Additional data examining a range of doses between the NOAEC and LOAEC from this study would reduce the uncertainty.

Also of note: only one concentration of dicamba DGA was tested in this study. Without multiple concentrations of the dicamba DGA formulation tested it is uncertain whether the amount of volatilized dicamba linearly correlates with the amount of dicamba DGA applied. Further, the influence of the atmospheric conditions of the test design (*i.e.*, temperature and relative humidity) on the amount of volatilized dicamba and subsequent entrapment in the polyurethane foam and on the observed phytotoxic and height response is uncertain.

Lastly, the track sprayer was not cleaned between the spray applications of different dicamba formulations; rather, the sprayer was "rinsed with a portion of the next treatment before spraying the petri dishes to minimize carryover." While the spray solutions were analytically confirmed prior to spraying, the employed methodology of rinsing versus cleaning introduces exposure source uncertainty.

Primary Reviewer: Nathan Miller NATHAN MILLER Digitally signed by NATHAN MILLER DN: c=US, o=U.S. Government, ou=USEPA, ou=Staff, cn=NATHAN MILLER, dnQualifier=0000042809 Date: 2016.11.08 10:41:51 -05'00'

Secondary Reviewer (required if study results are used quantitatively): Michael Wagman

MICHAEL WAGMAN Digitally signed by MICHAEL WAGMAN DN: c=US, o=U.S. Government, ou=USEPA, ou=Staff, cn=MICHAEL WAGMAN, dnQualifier=0000044023 Date: 2016.11.08 11:13:29 -05'00'